
रबड़ के धागे — विशिष्टि
(पहला पुनरीक्षण)

Rubber Threads — Specifications
(*First Revision*)

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Rubber and Rubber Products Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

This standard was first published in 1997. The first revision has been taken up to make pace with the latest technological developments.

The major changes in this revision are as follows:

- a) In this revision new requirement and test method for matric yield have been added. Method of test for determination of density has been modified; and
- b) This standard contains **5.7** which call for agreement between the purchaser and the supplier.

In the formulation of this standard considerable assistance has been derived from ISO/DIS 'General purpose rubber thread — Specification'.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*).'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

RUBBER THREADS — SPECIFICATIONS

(First Revision)

1 SCOPE

This standard prescribes the requirements, sampling procedure and methods of tests for 'rubber threads' used in production of elastic tapes, knitted garments and similar other applications in garment industry.

2 REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

<i>IS No.</i>	<i>Title</i>
IS 1070 : 1992	Reagent grade water (<i>third revision</i>)
IS 7086 (Part 1) : 1973	Methods of sampling and test for rubber compounding ingredients
IS 7503 : 2018 /ISO 1382 : 2012	Glossary of terms used in rubber industry

3 TERMINOLOGY

3.1 Count

3.1.1 Sectional Count

The sectional count of a rubber thread is one thousand times its cross sectional area, expressed in square millimetres.

3.1.2 Conventional Count

The conventional count of a rubber thread is the number of rubber threads which, when placed side by side measures 25.4 mm. The conventional count of a round rubber thread is obtained by dividing 25.4 by the diameter of the thread in mm.

The conventional count of a square thread is obtained by dividing 25.4 by the length of one side of its cross section, expressed in mm.

3.2 Density

The mass per unit volume of a test piece of thread, measured at standard laboratory temperature, expressed in mega grams per cubic metre.

3.3 Metric Yield

The un-stretched length of 1000 g of rubber thread expressed in metre.

3.4 Tensile Strength

The stress at which rubber thread breaks when it is stretched under specific condition. The value is expressed in mega pascals (MPa), based on the initial cross sectional area.

3.5 Elongation at Break

The increase in length of the thread at break, when it is stretched under specified conditions, expressed as a percentage increase of the original length.

3.6 Schwartz Value

It is the mean modulus of a rubber thread on extension and retraction during the sixth cycle, which has been extended to and retracted from an elongation 100 percent greater than the elongation at which the modulus is measured.

4 TYPES

This standard covers the following two types of rubber threads:

- a) Type 1 General purpose thread; and
- b) Type 2 Heat resistant thread.

5 REQUIREMENTS

5.1 General

The thread shall be made from good quality concentrated natural rubber latex or synthetic latex or a suitable blend of these two. Latex used for thread manufacture shall be mixed with suitable vulcanizing chemicals. The thread shall be made available on spools or as winding on mandrels or in tape form.

5.2 Appearance

The thread shall be of uniform gauge, free from bubbles, oxidized spots, unvulcanized sticky patches or other visible defects.

5.3 Counts

Round threads shall be available in counts of 30,40,60,80, 100 and 120 or any other count as agreed between the manufacturer and buyer.

For determining count, the procedure described in Annex A shall be used.

5.4 Tensile Strength and Elongation at Break

The tensile strength and elongation at break of rubber threads, when tested according to procedure given in Annex B and C shall comply with the requirement given in Table 1.

5.5 Schwartz Value

Schwartz value at 300 percent elongation is desired. When tested according to the procedure given in Annex D, it shall comply with the values given in Table 1.

5.6 Ageing Test

Separate test pieces of rubber threads are aged at $100 \pm 2^\circ\text{C}$ for 22 h and $150 \pm 2^\circ\text{C}$ for 2 h. Percentage retention of tensile strength and Schwartz value are determined in accordance with procedure given in Annex E. The value so determined shall conform to the requirements given in Table 1.

5.7 Metric Yield

Metric yield of rubber thread is determined according to the procedure given in Annex F. Requirement of metric yield shall be as agreed between the manufacturer and purchasers.

6 PACKING AND MARKING

6.1 Packing

The material shall be packed as agreed to between the purchaser and the supplier.

6.2 Marking

6.2.1 Each spool or mandrel or ten meter length of the ribbon shall be marked with the following information:

- a) Name of material;

- b) Indication of the source of manufacture;
- c) Type of material;
- d) Count;
- e) Net mass or length of material;
- f) Month and year of manufacture; and
- g) Lot or batch number.

6.2.2 BIS Certification Marking

The material may also be marked with the Standard Mark.

6.2.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations made thereunder. The details of the conditions under which the licence for use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

7 SAMPLING AND CRITERIA FOR CONFORMITY

7.1 Representative samples of the material shall be drawn as prescribed in IS 7086 (Part 1).

7.2 Number of Tests

Unless otherwise agreed to between the purchaser and the supplier, tests for all characteristics shall be conducted on a sample.

7.3 Criteria for Conformity

Lot shall be declared as conforming to the requirements of the specification if all the test results of the samples satisfy the corresponding specification requirements.

Table 1 Requirements for Rubber Thread

(Clauses 5.4, 5.5 and 5.6)

Sl No.	Characteristics	Requirements		
		General Purpose Thread	Heat Resistant Thread	Test Method
(1)	(2)	(3)	(4)	(5)
i)	Tensile strength, MPa, <i>Min</i>	24	24	Annex B
ii)	Elongation at break, percent, <i>Min</i>	750	750	Annex C
iii)	Schwartz value $\left[\text{Sv}_{300}^{400} \right]$ MPa, <i>Min</i>	2.0	2.0	Annex D
iv)	Tensile strength percent retained after 22 h ageing at $100 \pm 2^\circ\text{C}$, <i>Min</i>	65	75	Annex E
v)	Schwartz value, percentage retained after 2 h ageing at $150 \pm 2^\circ\text{C}$, <i>Min</i>	NP*	50	do

*Not prescribed

8 TEST METHODS

8.1 Test shall be conducted according to the methods prescribed in the specification.

8.2 All tests shall be carried out within one month of the date of receipt of the material by purchaser.

8.3 Quality of Reagents

Unless specified otherwise, pure chemicals and distilled water (*see* IS 1070 : 1992) shall be employed in the test.

NOTE — ‘Pure chemicals shall mean chemicals that do not contain impurities which affect the result of analysis.

ANNEX A

(Clause 5.3)

DETERMINATION OF COUNT

A-1 TEST METHOD

A-1.1 The count of a rubber thread is calculated as described in A-7, based on the density and weight of 1 m of thread.

A-1.2 The density is determined by the test method described in A-8.

A-2 TEST SPECIMENS

A-2.1 The specified number of straight thread samples shall be cut to approximately 1.05 m in length.

NOTE — Kinked or curved thread will introduce errors.

A-2.2 If these samples are taken from bobbins or from any other type of presentation in which the thread is under tension, they should be heat treated for 30 min in a thermostatically controlled oven at a temperature of $60 \pm 5^\circ\text{C}$. Where greater accuracy is required, the sample should then be allowed to relax for at least 48 h under the conditions at temperature of $27 \pm 1^\circ\text{C}$ and a relative humidity of 65 ± 2 percent.

A-2.3 Cutting

Two types of apparatus may be used for cutting to size. With the first (Method I) the cut is made with the test piece placed in a groove of a horizontal base. With the second (Method II) the thread is suspended and maintained in a vertical position by its own weight. The apparatus used for cutting test specimen by Method I and Method II are shown in Fig. 1 and 2 respectively.

A-3 METHOD I

A-3.1 Apparatus

A-3.1.1 Horizontal Flat Metallic Base

Rectangular in shape, having one or more longitudinal grooves.

A-3.1.2 Clamp

Fixed at position a few centimetres from the end of the groove. The grooves should have an equilateral triangular cross section with a base not less than 2 mm.

A-3.1.3 Cutting Device

Fitted to each end of the groove such that the distance between the cutting device blades is $1 \text{ m} \pm 1 \text{ mm}$.

A-4 PROCEDURE

Take the specified number of samples of thread, cut, and condition at a temperature of $27 \pm 1^\circ\text{C}$ and relative humidity 65 ± 2 percent. Lay each sample in a groove of the apparatus being careful to avoid stretching. Clamp and cut to length by means of the cutting device described above.

A-5 METHOD II

A-5.1 Apparatus

A-5.1.1 Rectangular Vertical Frame

At the upper and lower ends of which are mounted two metallic plates having the inside edges parallel and sharp.

A-5.1.2 Two Cutting Devices

The fixed blade of which consists of the inside edge of the metallic plate.

A-5.1.3 Two External Clamps

The clamps should be of a spring loaded type and the distance between the internal edges of the metallic plates should be $1 \text{ m} \pm 1 \text{ mm}$.

A-5.2 Procedure

Take the specified number of samples of thread, cut, prepare in accordance with A-2. Then suspend each sample from the upper clamp when it has been settled in the vertical position without stretch, fix it by means of the lower clamp. Then cut the test specimen to length with the two cutting devices, using the lower one first.

A-6 WEIGHING SPECIMENS

A-6.1 Use specimens already cut to the proper length and freed from any loose dusting powder by shaking or brushing them gently for the mass determination.

A-6.2 Determine the mass to an accuracy of ± 1 percent.

A-7 CALCULATION

A-7.1 Calculate the count of rubber thread as follows:

Round thread $C = 22.51 \sqrt{d/m}$

Square thread $C = 25.40 \sqrt{d/m}$

Where,

C = count of rubber thread;

d = density of thread, g/cm^3 ; and

m = mass of 1 m of the thread, g.

A-7.2 Make five determinations on different test specimens. Calculate the count of the specimen under examination from the arithmetic mean of the masses of the test specimens. Also state the maximum and minimum values obtained from the individual weighing.

A-8 DETERMINATION OF DENSITY

A-8.1 Principle

The method involves in identifying a suitable mixture of two liquids, in which the rubber thread remain suspended. The density of this mixture is equal to the density of the rubber thread.

Density of the thread is determined at $27 \pm 1^\circ\text{C}$.

A- 8.2 Apparatus

A-8.2.1 Glass Cylinder

Capacity, approximately 1 dm^3 .

A-8.2.2 Hydrometer or Hydrostatic Balance

To measure the density of liquid mixtures to an accuracy of not less than 0.005 Mg/m^3

A -8.3 Liquid Mixtures

A-8.3.1 Most of the rubber threads in the market have a density in the range 0.90 to 1.11 Mg/m^3 . Liquids selected

shall be miscible in all proportions. It is necessary to have a series of liquids having densities within the range. Each mixture differs from its neighbour by about 0.025 Mg/m^3 . Mixtures of ethanol (density 0.79 Mg/m^3) distilled water are suitable for densities below 1.00 Mg/m^3 . A saturated solution of zinc chloride in water and ethanol is suitable for densities greater than 1.00 Mg/m^3 .

Note — Mg = Mega gram or metric ton.

A-8.3.2 Before the mixtures are used they shall be homogeneous and free from air bubbles. They shall be kept in closed containers so as to avoid evaporation. They should be used at a temperature of $27 \pm 2^\circ\text{C}$.

A-8.4 Procedure

A-8.4.1 Take four test specimens approximately 10 mm long from the thread. Dip each specimen in ethanol and rub between the fingers to remove dusting powder and to eliminate any air bubbles from the surface.

A-8.4.2 Take a sufficient quantity of suitable liquids and thoroughly mix. Take-care not to form air bubbles. Introduce a test specimen of thread and by small additions of one or the other of the liquids, obtain the mixture in which the specimen remains suspended, that is, neither floats nor sinks.

A-8.4.3 Introduce a further three specimens, treated as in **A-8.4.1** into this mixture. If at least two specimens reach equilibrium between 3 min and 10 min after immersion, assume that the thread has the same density as that of the mixture. Determine the density of the mixture to the nearest 0.005 g/cm^3 .

ANNEX B

[Clauses 5.4, E-3.1 and E-4.1 and Table 1, Sl. No. (i)]

DETERMINATION OF TENSILE STRENGTH

B-1 PRINCIPLE

The stress at which the thread breaks when it is stretched under the specified conditions. The value is expressed in mega pascals (MPa).

B-2 APPARATUS

B-2.1 Constant Rate of Extensions (CRE) Type Tensile Testing Machine

With a load capacity selected such that the rubber thread breaks within 30 to 80 percent of full-scale deflection. A machine with capacities ranging from 0.1 to 20 N (10 to 2 000 gf) is generally adequate.

B-2.2 Clamping Assembly

Pneumatically operated clamps with one jaw having a flat steel face nominally 25 mm × 25 mm and the other jaw being one described in B-2.3 and B-2.4.

B-2.3 Acrylic Face

A convex clamp approximately 7.1 mm in radius by 25 to 12.5 mm.

B-2.4 Steel Face

A convex clamp 2.3 to 3.3 mm in radius nominally 25 × 5.6 ± 0.1 mm.

B-2.5 Black Rubber Tubing

1.6 mm bore with 0.8 mm wall.

B-2.6 Needle Threader, an Air Suction Nozzle, or Equivalent

For threading yarn through a rubber hose.

B-3 PROCEDURE

B-3.1 Determine the cross-sectional area of representative specimens in square millimetres.

B-3.2 Cut representative specimens to approximately 125 mm lengths.

B-3.3 Test the conditioned specimens in the standard atmosphere having a temperature of $27 \pm 1^\circ\text{C}$ and a relative humidity of 65 ± 2 percent.

B-3.4 Adjust the tensile machine as follows.

B-3.4.1 Gauge length, 50 mm.

B-3.4.2 Cross-head speed, 0.5 m/min.

B-3.4.3 Chart speed, 0.5 m/min.

B-3.4.4 Air pressure for pneumatic clamps, 414 MPa.

B-3.5 Locate the clamps so that the convex surfaces, acrylic or steel, are horizontal.

B-3.6 If required, cut two pieces of tubing approximately 12.5 mm long. Thread the test specimen through one piece of tubing using the needle threader or air suction nozzle, so that approximately 25 mm of rubber threads extend beyond one end of the tubing. Secure on the top clamp. Thread the free end through the second piece of tubing and secure in the bottom clamp.

B-3.7 Set the full-scale load of the tensile testing machine so that the estimated force to rupture the thread falls between 30 and 80 percent of the full-scale deflection.

B-3.8 Start the machine, observe and record the breaking force and elongation. If the specimen breaks within 3.0 mm of knot, disregard the result and test another specimen from the same package.

B-3.9 Repeat B-3.6 through B-3.8 until the required numbers of thread specimens have been broken.

ANNEX C

[Clause 5.4 and Table 1, Sl. No. (ii)]

ELONGATION AT BREAK

C-1 PRINCIPLE

The increase in length of the thread at break when it is stretched under the specified conditions expressed as the percentage increase of the original length. Thus, a specimen 25 mm in length which increases in length to 175 mm at break is said to *have an elongation* break of 600 percent.

C-2 PROCEDURE

When using the constant rate of extension (CRE) type tensile testing machine, read the elongation at maximum force from the load-elongation chart. Calculate the percent elongation on the basis of the nominal gauge length.

ANNEX D

[Clauses 5.5, E-3.1 and E-4.1 and Table 1, SI No. (iii)]

DETERMINATION OF SCHWARTZ VALUE

D-1 PRINCIPLE

The average of the stresses in newton per square meter calculated on the original cross-sectional area at a specified elongation measured on extension and retraction of a massaged thread. It is denoted by the symbol SV_{cn} where, c is the massaging elongation and n at which readings are taken, both expressed as percentages of the initial length. c and n should be multiples of 100 and, unless otherwise specified, c should be $n + 100$ percent. Preferred values of n are 300 and 500 percent according to the type of thread under test.

D-1.1 Constant Rate of Extensions Type Tensile Testing Machine

Described in **B-2**.

D-2 PROCEDURE

D-2.1 Use the procedure in **B-3** except allow the machine to cycle and reverse it at the desired elongation make six cycles of elongation and retraction without interruption to an elongation C percent and readings at n percent should be taken on the sixth cycle.

D-2.2 Make three measurements on different test specimens. The Schwartz value of the sample under examination should be taken as the arithmetic mean of the value obtained from the measurements.

D-3 CALCULATION

Let S_1 and S_2 be the forces at 300 percent elongation (on extension and retraction) on a thread of original cross-sectional area, which has been massaged by extension to and from an elongation of 400 percent.

Then,

$$\text{Schwartz value } \left[SV_{\frac{400}{300}} \right] = \frac{S_1 + S_2}{2}$$

ANNEX E

[Clauses 5.6 and Table 1, Sl No. (iv) and (v)]

AGEING TEST

E-1 GENERAL

This method covers the extent of deterioration of rubber threads by measuring the reduction in physical properties when a thread is maintained at a constant elongation under conditions more severe than those encountered in service. This method is a comparative indication only; it may not be possible to correlate the results with the actual duration of life in service.

E-2 PRINCIPLE

The initial physical properties of the thread are determined by the appropriate test method. The same test pieces maintained at 100 percent elongation are subjected to ageing in a circulating air oven. The residual physical properties are then measured and the percentage change reported.

E-2.1 Significance and Use

Conventional rubber ageing tests that are normally carried out on unstretched test specimens are of limited use in assessing the life of rubber threads since these are usually kept extended in use.

E-3 APPARATUS

E-3.1 Suitable test apparatus for the measurement of the selected physical property is described in Annexes B and D.

E-3.2 Masonite Forms or Other Suitable Holder

To maintain the test specimens at 100 percent elongation.

E-3.3 Circulating Hot Air Oven

Capable of maintaining temperature of $100 \pm 2^\circ\text{C}$ and $150 \pm 2^\circ\text{C}$.

E-4 PROCEDURE

E-4.1 Determine the initial selected physical properties by the procedure given in the appropriate Annexes B and D using the recommended number of test specimens.

E-4.2 Transfer the test specimen, maintained at 100 percent extension, to the Masonite form or other suitable holder.

E-4.3 Allow the test specimen to rest on the form for 60 ± 10 min in a relaxed state in the dark, in the standard

atmospheres at temperatures $27 \pm 2^\circ\text{C}$ and a relative humidity of 65 ± 5 percent for not less than 16 h before the test.

E-4.4 Place the test specimen in the circulating air oven for the period and temperature stated in the following table. Stabilize the oven temperature at the desired value before placing the forms in the oven, the heat capacity must be sufficient to ensure that the temperature is not lowered significantly when the forms are put in.

<i>Class of Test</i>	<i>Temperature °C</i>	<i>Time, h</i>
A (normal)	100 ± 2	22
B (heat resisting)	150 ± 2	2

Test B is more severe and is intended for use with threads classified as heat resistant.

E-4.5 After removal from the oven, maintain the test specimen under the conditions specified in **E-4.3** for a minimum of 16 h.

E-4.6 Re-determine the selected property by the method used for the initial value in **E-4.1**.

E-5 CALCULATION

Express the performance of the thread as the percentage retention of the initial value of the selected physical property as follows:

$$S_{RH} \frac{P_a}{P_o} \times 100$$

where,

S_{RH} = percentage of initial value of any property retained by the test specimen after dry oven heat treatment,

P_o = initial value of the selected physical property, and

P_a = value of that property after the ageing period.

E-6 REPORT

E-6.1 The report shall include the following:

- Full description of the sample and its origin;
- Physical property selected, the test method and apparatus used;
- Time and temperature of ageing; and
- Percentage retention of the physical property and the initial value.

ANNEX F*(Clause 5.7)***DETERMINATION OF MATRIC YIELD****F-1 PROCEDURE**

Condition a representative sample of rubber tread, as described in Annex A. Cut pieces of thread, determine their length (l), in metre and mass, in gram (w).

F-2 CALCULATION

Length of 1 gm of thread = l/w

Metric Yield = $1000 \times l/w$

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

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Amendments Issued Since Publication

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